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㊾ **Process for preparing n-alkylaminophenols.**

(57) To prepare an N-alkylaminophenol an aminophenol is subjected to reductive alkylation with an aliphatic or cyclic aldehyde or ketone in the presence of an organic solvent (e.g. an alcohol), hydrogen, and a reduction catalyst comprising platinum or palladium and at least one metal element selected from the IB, IIB, IVB, VB and VIB group of the Periodic Table, either supported on activated carbon, or which has been contact treated with a solution containing at least one said metal element.

The preferred amount of the metal in the catalyst is 0.001 to 0.5 part by weight. The preferred amount of the catalyst is 0.0001 to 0.02 part by weight as Pt or Pd per part of the aminophenol.

The catalyst can be recovered and reused.

The preparation of the catalyst is described.

PROCESS FOR PREPARING N-ALKYLAMINOPHENOLS

This invention relates to a process for preparing an N-alkylaminophenol by subjecting an aminophenol to reductive alkylation with an aldehyde or a ketone in the presence of an organic solvent, a catalyst for reduction, and hydrogen.

N-Alkylaminophenols are of extreme importance in industry as intermediates for heat-sensitive or pressure-sensitive dyes, xanthene dyes, fluorescent dyes, etc.

It is conventionally known to prepare an N-alkylaminophenol by reductive alkylation of an alkylaminophenol and an aldehyde or a ketone in the presence of an organic solvent, a catalyst for reduction, and hydrogen.

However, the conventional processes have the following disadvantage. As the conventional noble metal catalysts for use in the reductive alkylation, such as platinum or palladium catalysts, have an ability to reduce an aromatic ring when used as such, nuclear hydrogenation of the aromatic ring may be caused as a side reaction depending on the reaction conditions, resulting in a decrease in the yield of the desired N-alkylaminophenols. Industrially, since these catalysts are expensive, generally it is necessary to use them repeatedly, but this has the following industrially serious problems in addition to the nuclear hydrogenation of aromatic ring. First the aminophenol and the aldehyde or ketone are condensed to form a heavy matter. Also the aldehyde or ketone is reduced to increase the by-production of an alcohol.

Of the problems, concerning the by-production of an alcohol, for example, JP-A-57-165349, JP-A-58-26844, and JP-A-58-194843 disclose techniques for suppressing the by-production of an alcohol by adding a solid sulfur compound during the course of the reductive alkylation, or using a platinum sulfide catalyst. (The term "JP-A" as used herein means an "unexamined published Japanese patent application".)

However, though these techniques can suppress the by-production of an alcohol to a some extent, the reductive alkylation as a main reaction is also suppressed at the same time; thus there is a problem that an unstable Schiff's base of an aminophenol is condensed to form a heavy matter. These techniques also have disadvantages that when the catalyst is used repeatedly, the reaction can be controlled only with difficulty due to elimination of sulfur from the catalyst.

Further almost no conventional techniques have been mentioned about a technique for suppressing nuclear hydrogenation of an aromatic ring, especially no technique for suppressing nuclear hydrogenation of an aromatic ring in the preparation of an N-alkylaminophenol has been known.

An object of this invention is to provide an industrially advantageous process for preparing an N-alkylaminophenol which can suppress undesirable side reactions such as nuclear hydrogenation of an aromatic ring and reaction which forms heavy matters as described above, and which enables a catalyst to be used repeatedly with a high yield of the desired products.

The present inventors have found that the above-described object can be attained by use of a platinum or palladium catalyst containing a specific metal element selected in the Periodic Table, or a platinum or palladium catalyst which has been contact treated with a solution containing a specific metal element.

Thus a first aspect of this invention concerns a process for preparing an N-alkylaminophenol, which comprises subjecting an aminophenol to reductive alkylation with an aldehyde or a ketone in the presence of an organic solvent, a catalyst for reduction, and hydrogen, wherein the catalyst for reduction comprises platinum and at least one metal element selected from metal elements belonging to the IB group, IIB group, IVB group, VB group and VIB group of the Periodic Table, supported on activated carbon, or comprises palladium and at least one metal element selected from metal elements belonging to the IB group, IIB group, IVB group, VB group and VIB group of the Periodic Table, supported on activated carbon.

A second aspect of this invention concerns a process for preparing an N-alkylaminophenol, which comprises subjecting an aminophenol to reductive alkylation with an aldehyde or a ketone in the presence of an organic solvent, a catalyst for reduction, and hydrogen, wherein a platinum or palladium catalyst supported on activated carbon, which has been contact treated with a solution containing at least one metal element selected from metal elements belonging to the IB group, IIB group, IVB group, VB group, and VIB group of the Periodic Table.

Aminophenols which can be used in this invention include, for example, o-aminophenol, m-aminophenol and p-aminophenol.

Aldehydes which can be used in this invention include, for example, aliphatic aldehydes such as formaldehyde, acetaldehyde, propionaldehyde, butyraldehyde, and isovaleraldehyde; cyclic aldehydes such as cyclohexanecarboxyaldehyde and furfural; and aromatic aldehydes such as benzaldehyde and p-tolualdehyde.

Ketones which can be used in this invention include, for example, aliphatic ketones such as acetone, 2-

butanone, and 4-methyl-2-pentanone; cyclic ketones such as cyclopentanone and cyclohexanone; and aromatic ketones such as acetophenone and p-methylacetophenone.

N-Alkylaminophenols which can be used in this invention include, for example, N-monoalkylaminophenols such as N-ethylamiophenol, N-propylaminophenol, N-butylamino-phenol, N-cyclohexylaminophenol, N-benzylaminophenol, and N-isopropylaminophenol; and N,N-dialkylaminophenols such as N,N-diethylaminophenol, N,N-dibutylaminophenol, N-ethyl-N-isobutylaminophenol, and N-ethyl-N-isoamylaminophenol.

Organic solvents which can be used in this invention include, for example, aliphatic alcohols such as methanol and ethanol.

A catalyst for reduction which can be used in this invention is a platinum or palladium catalyst containing a specific metal element selected in the Periodic Table, or a platinum or palladium catalyst which has been contact treated with a solution containing a specific metal element selected in the Periodic Table.

The term "metal element selected in the Periodic Table" is intended to be at least one metal element selected from the IB group, IIB group, IVB group, VB group, and VIB group of the Periodic Table.

Typical examples of such metallic elements include Cu, Zn, Cd, Sn, Pb, As, Sb, Se and Te, with Pb, Te, Cu: and As being preferable.

The content of the metal in the catalyst for reduction is preferably in the range of from 0.001 to 0.5 part by weight, more preferably from 0.005 to 0.2 part by weight, per part by weight of platinum or palladium. If it is less than 0.001 part by weight, the effect of suppressing nuclear hydrogenation of an aromatic ring may be insufficient. On the other hand, if it exceeds 0.5 part by weight, the activity of the catalyst for reduction on the reductive alkylation which is the main reaction may be decreased so that the aminophenol and the aldehyde or ketone are likely to be condensed to form a heavy matter.

In the present invention, methods using the platinum or palladium catalyst which has been contact treated with a solution containing a specific metal element selected in the Periodic Table as described above are as follows:

(1) a method wherein a catalyst slurry obtained by adding a metal salt containing a metal element selected in the Periodic Table to a slurry comprising an organic solvent and a platinum or palladium catalyst supported on activated carbon for use in the reductive alkylation is used for the reductive alkylation as is, or

(2) a method wherein a solid catalyst obtained by filtering the catalyst slurry mentioned in (1) is used for the reductive alkylation.

Typical embodiments will be mentioned as follows:

The method (1) can be carried out by charging a fresh catalyst, or the catalyst which has been used in the reaction and recovered, together with the organic solvent, and then adding the metal salt alone or as a solution in an organic solvent with stirring. This procedure may be carried out either under an inert gas atmosphere, N_2-pressurized atmosphere, or H_2-pressurized atmosphere. The temperature and the time of the treatment are not specifically limited, but generally the treatment is sufficiently carried out at from room temperature to 90 °C for from 5 minutes to 2 hours. After this contact treatment, it is preferable to treat the resulting catalyst at room temperature and at atmospheric pressure taking into consideration the reductive alkylation to be carried out thereafter.

The method (2) can be carried out by charging a fresh catalyst, or the catalyst which has been used in the reaction and recovered, together with the organic solvent, adding the metal salt alone or as a solution with stirring, and after stirring, recovering a solid catalyst by filtration. This operation may be carried out either under an inert gas atmosphere at atmospheric pressure or under N_2-pressurised atmosphere. The temperature and the time of the operation are not specifically limited, but generally the treatment is sufficiently carried out at from room temperature to 90 °C for from 5 minutes to 2 hours.

In the catalyst for reduction which has been contact treated by the method (1) or (2), almost the whole amount of the metal element used in the contact treatment is contained therein.

In the case of the method (2), the solvent to be used for the formation of the catalyst slurry is not necessarily the organic solvent to be used for the reductive alkylation, but it is preferably the same solvent as that used for the reductive alkylation or water,taking into consideration the contamination of the reaction system of the reductive alkylation.

As the metal salt used for obtaining the catalyst slurry, oxides, chlorides, bromides, sulfates, nitrates, phosphates, acetates and oxalates of the metal elements selected in the Periodic Table can be used, but from the standpoint of uniform adsorption of the metal element on the platinum or palladium catalyst, acetates are most preferable.

The amount of the metal element to be used for the contact treatment is preferably in the range of from 0.001 to 0.5 part by weight, more preferably from 0.005 to 0.2 parts by weight, per part by weight of platinum or palladium. If it is less than 0.001 part by weight, the effect of suppressing nuclear hydrogenation of an aromatic ring may be insufficient. On the other hand, if it exceeds 0.5 part by weight, the activity of the catalyst for reduction on the reductive alkylation which is the main reaction may be decreased so that the aminophenol and the aldehyde or ketone are likely to be condensed to form a heavy matter.

The reaction of this invention is a reaction which gives an N-alkylaminophenol from an aminophenol and an aldehyde or a ketone by reductive alkylation in the presence of the above-described organic solvent, hydrogen and catalyst for reduction. The reaction may be carried out by feeding the alkylaminophenol, organic solvent and the catalyst for reduction under hydrogen pressure, continuously feeding the aldehyde or ketone, or feeding them all at once to bring about the reaction. However, from the viewpoint of carrying out the reaction smoothly, the aldehyde or ketone is preferably fed continuously, and it is more preferable to continuously add a small amount of an organic carboxylic acid such as acetic acid corresponding to the feeding of the aldehyde or ketone. It is sufficient that the reaction temperature is in the range of from room temperature to 150 °C, and the reaction pressure may be in the range of from 2 to 30 kg/cm^{2}G.

The amount of the catalyst for reduction to be used is preferably in the range of from 0.0001 to 0.02 part by weight, more preferably from 0.001 to 0.01 part by weight, as platinum or palladium in the catalyst, per part by weight of the starting material aminophenol. If it is less than 0.0001 part by weight, the rate of the main reaction becomes unduly slow, and the formation of heavy matters as a side reaction may be accelerated. Conversely, if it is more than 0.02 part by weight, the reduction of the aromatic ring may be accelerated. The catalyst for reduction may be used only once, but usually it is used repeatedly on an industrial scale. Particularly, since almost the whole amount of the metal element selected in the Periodic Table remains in the catalyst used herein even after the catalyst has been used once, no special treatment is needed in the case that this catalyst for reduction is used repeatedly, and the effect of this invention can be maintained. In the case of repeated use since there is a loss of the catalyst by finely dividing and a loss of the recovery by filtration, a small amount of the fresh catalyst is supplemented as occasion may demand and used for the next reductive alkylation.

It is also possible to add the metal element selected in the Periodic Table in such an amount as to meet the fresh catalyst to be supplemented.

As described above, an N-alkylaminophenol can be obtained in the process for preparing an N-alkylaminophenol by subjecting an aminophenol to reductive alkylation with an aldehyde or a ketone in the presence of an organic solvent, a catalyst for reduction, and hydrogen according to the present invention while suppressing side reactions such as nuclear hydrogenation of an aromatic ring and a reaction to form heavy matters as described above with a high yield of the desired products. Especially, when the catalyst for reduction is used repeatedly, an N-alkylaminophenol can be prepared with an industrially outstanding advantage.

Now, the present invention will be described in more detail with reference to working examples.

Example 1

In a 500 cc-volume SUS-made autoclave equipped provided with a stirrer were charged 32.7 g (0.30 mole) of m-aminophenol, 185.5 g of methanol, and 1.6 g of a commercially available catalyst comprising 5% by weight of platinum supported on activated carbon containing 0.1 part by weight of lead per part by weight of platinum, and 67.6 g of a methanol solution containing 45% by weight of acetaldehyde (acetaldehyde content: 0.69 mole) and 0.20 g (0.0033 mole) of acetic acid were introduced over a period of 1 hour under constant conditions of 40 °C and 10 kg/cm^{2}G of hydrogen pressure. After completion of the introduction of acetaldehyde, the mixture was maintained at the same temperature for an additional 150 minutes and allowed to cool. The catalyst was removed by filtration, and the resulting filtrate was analyzed by gas chromatography, liquid chromatography, and GPC (gel permeation chromatography). As a result, it was found to be 100% of the convention of m-aminophenol (calculated by m-aminophenol consumed/m-aminophenol charged x 100), 95.9% of the selectivity of 3-(diethylamino)phenol, 0.5% of the selectivity of a nuclear hydrogenated product of benzene ring (nuclear hydrogenated product: 3-(diethylamino)-2-hexen-1-one), and 2.1% of the selectivity of heavy matter (values of all selectivity being relative to m-aminophenol).

Examples 2 to 4

Using a catalyst obtained after being used in Example 1 and then recovered, the reaction was carried out in a similar manner to Example 1. Afterwards, the reaction was carried out using the catalyst recovered again and again, the results being shown in Table 1.

Table 1

Example	Number of times of catalyst used	Yield of DEMP	Yield of nuclear hydrogenated product	Yield of heavy matter
		(%)	(%)	(%)
2	2	95.2	2.5	1.7
3	3	95.8	2.1	2.0
4	4	95.1	2.8	2.1

Note: DEMP: 3-(Diethylamino)phenol
All the conversion of m-aminophenol was 100%.

Examples 5 to 8

The reaction of Examples 1 to 4 was repeated, except that 1.6 g of a commercially available catalyst comprising 5% by weight of platinum supported on activated carbon containing 0.06 part by weight of tellurium per part by weight of platinum. The results are shown in Table 2.

Table 2

Example	Number of times of catalyst used	Yield of DEMP	Yield of nuclear hydrogenated product	Yield of heavy matter
		(%)	(%)	(%)
5	1	96.8	0.3	2.6
6	2	96.3	2.1	1.3
7	3	95.7	2.6	1.3
8	4	96.0	2.5	1.1

Note: All the conversion of m-aminophenol was 100%.

Examples 9 to 12

The reaction of Examples 1 to 4 was repeated, except that 1.6 g of a commercially available catalyst comprising 5% by weight of platinum supported on activated carbon containing 0.15 part by weight of copper per part by weight of platinum. The results are shown in Table 3.

Table 3

Example	Number of times of catalyst used	Yield of DEMP	Yield of nuclear hydrogenated product	Yield of heavy matter
		(%)	(%)	(%)
9	1	93.3	0.3	5.7
10	2	93.8	1.3	4.0
11	3	93.5	1.4	4.1
12	4	93.7	1.2	4.3
Note: All the conversion of m-aminophenol was 100%.				

Comparative Examples 1 to 4

The reaction was carried out by the same operation as in Examples 1 to 4, except that 1.6 g of a catalyst comprising 5% by weight of platinum supported on activated carbon (which is a commercially available product not containing any metal element selected in the Periodic Table) was used as the catalyst. The results are as shown in Table 4.

Table 4

Comp. Example	Number of times of catalyst used	Yield of DEMP	Yield of nuclear hydrogenated product	Yield of heavy matter
		(%)	(%)	(%)
1	1	95.5	1.5	2.4
2	2	87.7	8.0	2.0
3	3	87.1	7.4	3.0
4	4	87.5	7.7	2.6
Note: All the conversion of m-aminophenol was 100%.				

Examples 13 to 16

3-(Di-n-butylamino)phenol was synthesized by conducting the reaction in the same manner as in Examples 1 to 4, except that 103.8 g of a methanol solution containing 50% by weight of n-butyraldehyde (n-butyraldehyde content: 0.72 mole) was used in place of the methanol solution containing 45% by weight of acetaldehyde and introduced over a period of 1 hour. The results are shown in Table 5.

Table 5

Example	Number of times of catalyst used	Yield of DBMP (%)	Yield of nuclear hydrogenated product (%)	Yield of heavy matter (%)
13	1	95.1	1.3	1.6
14	2	94.3	1.9	1.8
15	3	94.5	1.8	1.7
16	4	94.6	1.7	1.7

Note: All the conversion of m-aminophenol was 100%.
DBMP: 3-(Di-n-butylamino)phenol
Nuclear hydrogenated product: 3-(Di-n-butylamino)-2-hexen-1-one

Examples 17 to 20

3-(Cyclohexylamino)phenol was synthesised by conducting the reaction in the same manner as in Examples 1 to 4, except that 70.6 g of a methanol solution containing 50% by weight of cyclohexanone (cyclohexanone content: 0.36 mole) was used in place of the methanol solution containing 45% by weight of acetaldehyde and introduced over a period of 30 minutes. The results are shown in Table 6.

Table 6

Example	Number of times of catalyst used	Yield of OCMP (%)	Yield of nuclear hydrogenated product (%)	Yield of heavy matter (%)
17	1	96.1	1.0	0.3
18	2	95.3	2.5	0.4
19	3	95.5	2.3	0.5
20	4	95.6	2.3	0.5

Note: All the conversion of m-aminophenol was 100%.
OCMP: 3-(Cyclohexylamino)phenol
Nuclear hydrogenated product: 3-(Cyclohexylamino)-2-hexen-1-one

Examples 21 to 24

3-(N-Ethyl-N-isobutylamino)phenol was synthesized by following the procedure of Examples 1 to 4. In a 500 cc-volume SUS-made autoclave equipped with a stirrer were charged 32.7 g (0.30 mole) of m-aminophenol, 185.5 g of methanol, and 1.6 g of a commercially available catalyst comprising 5% by weight of platinum supported on activated carbon containing 0.1 part by weight of lead per part by weight of platinum, and 47.6 g of a methanol solution containing 50% by weight of isobutyraldehyde (isobutyraldehyde content: 0.33 mole) was introduced over a period of 30 minutes at constant conditions of 40° C and 10 kg/cm^{2}G. After completion of the introduction of isobutyr aldehyde, the mixture was maintained at the same temperature for an additional 60 minutes, after which 41.1 g of a methanol solution containing 45% by weight of acetaldehyde (acetaldehyde content: 0.42 mole) and 0.20 g (0.0033 mole) of acetic acid were continuously introduced over a period of 30 minutes. After completion of the introduction of acetaldehyde, the mixture was maintained at the same temperature for an additional 70 minutes and allowed to cool. The catalyst was removed by filtration, and the resulting filtrate was analyzed by gas chromatography, liquid chromatography, and GPC. The catalyst recovered was reused in the next reaction. The results are as shown in Table 7.

Table 7

Example	Number of times of catalyst used	Yield of EBMP	Yield of nuclear hydrogenated product	Yield of heavy matter
		(%)	(%)	(%)
21	1	95.1	1.2	1.7
22	2	94.2	2.1	1.7
23	3	94.2	1.9	1.5
24	4	94.4	1.9	1.5

Note: All the conversion of m-aminophenol was 100%.
EBMP: 3-(N-Ethyl-N-isobutylamino)phenol
Nuclear hydrogenated product: 3-(Isobutylamino)-2-hexen-1-one

Examples 25 to 28

3-(N-Ethyl-N-isoamylamino)phenol was synthesized by following the procedure of Examples 21 to 24, except that 56.8 g of a methanol solution containing 50% by weight of isovaleraldehyde (isovaleraldehyde content: 0.33 mole) was used in place of the methanol solution containing 50% by weight of isobutyraldehyde and introduced over a period of 30 minutes. The results are shown in Table 8.

Table 8

Example	Number of times of catalyst used	Yield of EAMP	Yield of nuclear hydrogenated product	Yield of heavy matter
		(%)	(%)	(%)
25	1	94.5	1.1	1.4
26	2	93.2	2.0	1.3
27	3	93.4	2.1	1.2
28	4	93.4	1.9	1.3

Note: All the conversion of m-aminophenol was 100%.
EAMP: 3-(N-Ethyl-N-isoamylamino)phenol
Nuclear hydrogenated product: 3-(Isoamylamino)-2-hexen-1-one

Example 29

In a 500 cc-volume SUS-made autoclave equipped with a stirrer were charged 185.5 g of methanol, 1.6 g of a catalyst comprising 5% by weight of platinum supported on activated carbon, and 0.015 g of lead acetate. The mixture was stirred at room temperature for one hour. Thereafter, 32.7 g (0.30 mole) of m-aminophenol was charged, the hydrogen pressure was maintained at 10 kg/cm^2, and 67.5 g of a methanol solution containing 45% by weight of acetaldehyde (acetaldehede content: 0.69 mole), and 0.20 g (0.0033 mole) of acetic acid were continuously introduced over a period of 1 hour at 40 ° C. After completion of the introduction of acetaldehyde, the mixture was maintained at the same temperature for an additional 90 minutes and allowed to cool. The catalyst was removed by filtration, and the resulting filtrate was analyzed by gas chromatography, liquid chromatography, and GPC. As a result, it was found to be 100% of the conversion of m-aminophenol (calculated by m-aminophenol consumed/m-aminophenol charged x 100), 94.5% of the selectivity of 3-(diethylamino)phenol, 1.7% of the selectivity of a nuclear hydrogenated product of benzene ring (nuclear hydrogenated product: 3-(diethylamino)-2-hexen-1-one), and 3.4% of the selectivity of heavy matter (values of all selectivity being relative to m-aminophenol).

Example 30

The reaction was carried out by a similar procedure to Example 29, except for using a catalyst which had been recovered after being used in Example 29 and without again treating with lead acetate. As a result of the analysis, the conversion of m-aminophenol was 100%, the selectivity of 3-(diethylamino)phenol was 94.5%, the selectivity of a nuclear hydrogenated product of benzene ring was 1.3%, and the selectivity of heavy matters was 2.9%.

Comparative Example 5

The reaction was carried out by a similar procedure to Example 29, except for using a catalyst which had been used in the reaction once without treating with lead acetate and which was not again treated with lead acetate. As a result of the analysis, the conversion of m-aminophenol was 100%, the selectivity of 3-(diethylamino)phenol was 87.8%, the selectivity of a nuclear hydrogenated product of benzene ring gas 7.2%, and the selectivity of heavy matter was 3.3%.

Comparative Example 6

The reaction was carried out by a similar procedure to Example 29, except for using the catalyst which had been recovered after being used in Comparative Example 5 and without again treating with lead acetate. As a result of the analysis, the conversion of m-aminophenol was 100%, the selectivity of 3-(diethylamino)phenol was 87.8%, the selectivity of a nuclear hydrogenated product of benzene ring was 7.0%, and the selectivity of heavy matter was 3.5%.

Example 31

The reaction was carried out by a similar procedure to Example 29, except that a catalyst prepared as follows was used: a 200 cc-volume glass-made round bottom flask was charged with 1.6 g of a catalyst comprising 5% by weight of platinum supported on activated carbon and 100 g of water to make a catalyst slurry, after which 0.015 g of lead acetate was added, and the mixture was heated at 80 ° C for 1 hour with stirring. After cooling the catalyst slurry, it was filtered under aspiration and then washed twice with 50 g of water, after which the solid catalyst was recovered. As a result, the conversion of m-aminophenol was 100%, the selectivity of 3-(diethylamino)phenol was 94.8%, the selectivity of a nuclear hydrogenated product of benzene ring was 2.8%, and the selectivity of heavy matter was 1.7%.

Example 32

The reaction was carried out by a similar procedure to Example 29, except for using the catalyst which had been recovered after being used in Example 31 without again treating with lead acetate. As a result of the analysis, the conversion of m-aminophenol was 100%, the selectivity of 3-(diethylamino)phenol was 95.0%, the selectivity of a nuclear hydrogenated product of benzene ring was 3.0%, and the selectivity of heavy matter was 1.5%.

Examples 33 and 34

The reaction was carried out twice by following the procedure of Examples 29 and 30, except that the treatment was performed using copper acetate in place of the lead acetate.

Examples 35 and 36

The reaction was carried out twice by following the procedure of Examples 29 and 30, except that the treatment was performed using zinc acetate in place of the lead acetate.

Examples 37 and 38

The reaction was carried out twice by following the procedure of Examples 29 and 30, except that the treatment was performed using arsenic acetate in place of the lead acetate. The results of Examples 33 to 38 are shown in Table 9.

Table 9

Example	Yield of DEMP	Yield of Nuclear Hydrcgenated Product	Yield of Heavy Matter
	(%)	(%)	(%)
33	92.9	1.7	4.4
34	92.5	1.3	3.9
35	92.8	2.8	2.7
36	93.0	3.0	2.5
37	91.7	3.5	3.9
38	92.2	3.0	4.1

Note: DEMP: 3-(Diethylamino)phenol
All the conversion of m-aminophenol was 100%.

Examples 39 and 40

The reaction was carried out twice by following the procedure of Examples 29 and 30, except that 103.8 g of a methanol solution containing 50% by weight of n-butyraldehyde (n-butyraldehyde content: 0.72 mole) was used in place of the methanol solution containing 45% by weight of acetaldehyde. The results are shown in Table 10.

Table 10

Example	Yield of DBMP	Yield of Nuclear Hydrogenated Product	Yield of Heavy Matter
	(%)	(%)	(%)
39	94.5	1.5	1.7
40	94.3	1.6	2.0

Note: DBMP: 3-(Di-n-butylamino)phenol
Nuclear hydrogenated product:
3-(Di-n-butylamino)-2-hexen-1-one
All the conversion of m-amiophenol was 100%.

Examples 41 and 42

The reaction was carried out twice by following the procedure of Examples 29 and 30, except that 70.6 g of a methanol solution containing 50% by weight of cyclohexanone (cyclohexanone content: 0.72 mole) was used in place of the methanol solution containing 45% by weight of acetaldehyde. The results are shown in Table 11.

Table 11

Example	Yield of OCMP	Yield of Nuclear Hydrogenated Product	Yield of Heavy Matter
	(%)	(%)	(%)
41	95.5	2.5	0.4
42	95.7	2.3	0.5

Note: OCMP: 3-(Cyclohexylamino)phenol
Nuclear hydrogenated product:
3-(Cyclohexylamino)-2-hexen-1-one
All the conversion of m-aminophenol was 100%.

Examples 43 and 44

3-(N-Ethyl-N-butylamino)phenol was synthesized by following the procedure of Examples 29 and 30. In a 500 cc-volume SUS-made autoclave equipped with a stirrer were charged 185.5 g of methanol, 1.6 g of a catalyst comprising 5% by weight of platinum supported on activated carbon, and 0.015 g of lead acetate, and the mixture was stirred at room temperature for one hour. Thereafter, 32.7 g (0.30 mole) of m-aminophenol was charged, the hydrogen pressure was maintained at 10 kg/cm^2, and 47.6 g of a methanol solution containing isobutyraldehyde (isobutyraldehyde content: 0.33 mole) was continuously introduced over a period of 30 minutes at 40° C. After completion of the introduction of isobutyraldehyde, the mixture was maintained at the same temperature for an additional 1 hour, after which 41.1 g of a methanol solution containing 45% by weight of acetaldehyde (acetaldehyde coatent: 0.42 mole), and 0.20 g (0.0033 mole) of acetic acid were continuously introduced over a period of 30 minutes. After completion of the introduction of acetaldehyde, the mixture was maintained at the same temperature for an additional 70 minutes and allowed to cool. The filtrate obtained by removing the catalyst by filtration was analyzed by gas chromatography, liquid chromatography, and GPC. The results are shown in Table 12.

Table 12

Example	Yield of EBMP	Yield of Nuclear Hydrogenated Product	Yield of Heavy Matter
	(%)	(%)	(%)
43	94.2	2.1	1.7
44	94.5	1.9	1.5

Note: EBMP: 3-(N-Ethyl-N-isobutylamino)phenol
Nuclear hydrogenated product:
3-(Isobutylamino)-2-hexen-1-one
All the conversion of m-amiophenol was 100%.

Examples 45 and 46

The reaction was carried out twice by following the procedure of Examples 43 and 44, except that 56.8 g of a methanol solution containing 50% by weight of isovaleraldehyde (isovaleraldehyde content: 0.33 mole) was used in place of the methanol solution containing 50% by weight of n-butyraldehyde. The results are shown in Table 13.

Table 13

Example	Yield of EAMP	Yield of Nuclear Hydrogenated Product	Yield of Heavy Matter
	(%)	(%)	(%)
45	93.5	2.2	1.4
46	93.7	2.0	1.4

Note: EAMP: 3-(N-Ethyl-N-isoamylamino)phenol
Nuclear hydrogenated product:
3-(Isoamylamino)-2-hexen-1-one
All the conversion of m-aminophenol was 100%.

Claims

1. A process for preparing an N-alkylaminophenol, which comprises subjecting an aminophenol to reductive alkylation with an aldehyde or a ketone in the presence of an organic solvent, a catalyst for reduction, and hydrogen, wherein said catalyst for reduction comprises platinum and at least one metal element selected from metal elements belonging to the IB group, IIB group, IVB group, VB group and VIB group of the Periodic Table, supported on activated carbon, or comprises palladium and at least one metal element selected from metal elements belonging to the IB group, IIB group, IVB group, VB group and VIB group of the Periodic Table, supported on activated carbon.

2. A process for preparing an N-alkylaminophenol, which comprises subjecting an aminophenol to reductive alkylation with an aldehyde or a ketone in the presence of an organic solvent, a catalyst for reduction, and

hydrogen, wherein said catalyst for reduction comprises a platinum or palladium catalyst supported on activated carbon, which has been contact treated with a solution containing at least one metal element selected from metal elements belonging to the IB group, IIB group, IVB group, VB group and VIB group of the Periodic Table.

3. A process as claimed in Claim 2, wherein the solution used in the contact treatment is a solution in which a salt of the metal element of Claim 2 selected in the Periodic Table, which is soluble in the organic solvent used in the reductive alkylation or in water, is used.

4. A process as claimed in any preceding claim, wherein the amount of the metal element selected in the Periodic Table used in the contact treatment is in the range of from 0.001 to 0.5 part by weight per part of platinum or palladium.

5. A process as claimed in any preceding claim, wherein the metal element selected in the Periodic Table is lead, tellurium, copper or arsenic.

European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 90312304.0

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	DERWENT PUBLICATIONS LTD., London Questel Telesystems (WPI), DW 7418 * Abstract * & NL-A-7 213 825 (BASF) --	1	C 07 C 215/76 C 07 C 213/08
A	PATENT ABSTRACTS OF JAPAN, unexamined applications, C field, vol. 10, no. 214, July 25, 1986 THE PATENT OFFICE JAPANESE GOVERNMENT page 79 C 362 * Kokai-No. 61-53 247 (TAOKA CHEM) * --	1	
A	DE - A1 - 3 039 085 (BASF) * Claims * --	1	
A	EP - A1 - 0 181 505 (KANZAKI PAPER MANUFACTURING) * Example 4 * ----	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

C 07 C 215/00
C 07 C 213/00
C 07 C 209/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	11-01-1991	KÖRBER

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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